

**Los Alamos National Laboratory
Radiological Protection Program**

CY 2003

**Performance Indicators for
Radiation Protection**

February 18, 2004

**HSR-12
Radiation Protection Services
ALARA Metrics
(505) 665-7921**

Prepared by: _____ Date: _____
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MANAGEMENT SUMMARY

INTRODUCTION

This report covers all radiological operations conducted at Los Alamos National Laboratory (LANL), in Los Alamos, NM. It includes University of California (UC) operations as well as contractors and subcontractors. The majority of the information (data) in this report comes from two sources. The first source, dosimetry information, is obtained from the Radiation Information Management Team of HSR-12 (external dosimetry current through CY2003; internal data current through CY2002). The remainder of the information is obtained from the DOE Occurrence Reporting and Processing System (ORPS) [DOE Order 232.1]. The data contained in this report are current as of the date that the report was prepared, and are accurate to the best of the preparer's knowledge.

1.0 GENERAL SITE INFORMATION

A. Major radionuclides at the site:

Plutonium, Uranium, Tritium and mixed activation products

2.0 EXTERNAL RADIATION EXPOSURE

A. Radiation Worker Dose Limits: (10CFR835)

Whole Body 5 rem
Lens-of-the-Eye 15 rem
Extremity 50 rem

B. Collective Radiation Dose: (person-rem)

<u>Year</u>	<u>External Dose (EDE)</u>	<u>Total Effective Dose (TEDE)</u>
1992	132	140
1993	142	168
1994	178	183
1995	235	236
1996	189	199
1997	182	200
1998	158	170
1999	129	133
2000	87	212
2001	114	120
2002	160	164
2003	224	224

Individual Data:

(1) Maximum Individual Dose Received: (rem)

<u>Year</u>	<u>Whole Body (EDE)</u>	<u>Neutron</u>	<u>Extremity</u>
1994	1.743	1.515	na
1995	1.949	1.705	na
1996	1.954	1.465	na
1997	1.794	1.374	35.230
1998	1.846	1.370	28.100
1999	1.910	1.451	6.888
2000	1.048	0.831	4.932
2001	3.607	1.474	14.564
2002	2.214	1.731	27.868
2003	1.935	1.564	20.586

(2) Average Individual Non-Zero Dose Received (whole body external):

<u>Year</u>	<u>Average Individual non-zero dose (rem)</u>
1994	0.073
1995	0.089
1996	0.093
1997	0.080
1998	0.082
1999	0.086
2000	0.063
2001	0.090
2002	0.098
2003	0.112

D. Number of Personnel in Dose Categories: External (EDE)

<u>Dose Category (rem)</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>
Zero	11554	10557	11945	11434
0.001-0.100	1159	981	1247	1478
0.101-0.500	201	239	313	400
0.501-1.000	22	43	53	79
1.001-1.500	3	4	11	17
1.501-2.000	0	0	5	15
2.001-2.500	0	0	1	0
2.501-5.000	0	0	0	0
> 5.000	4	0	0	0
Number Monitored	12943	11824	13575	13423

3.0 PERSONNEL CONTAMINATIONS (DOE Order 232.1A criteria)

A. Number of skin contaminations:

1993 =	32
1994 =	42
1995 =	40
1996 =	43
1997 =	25
1998 =	25
1999 =	31
2000 =	17
2001 =	30
2002 =	10
2003 =	12

B. Number of personal clothing contaminations:

1993 =	22
1994 =	28
1995 =	16
1996 =	21
1997 =	14
1998 =	10
1999 =	9
2000 =	6
2001 =	10
2002 =	14
2003 =	16

4.0 OCCURRENCES/INCIDENTS

A. Number of DOE Order 232.1A reports filed at LANL relating to radiation protection and their classifications:

Year (CY)	Number of Reports (DOE Order 232.1) <u>All</u>	Number of Reports Related to Radiation <u>Protection</u>	Personnel Contamination <u>Reports</u>
1994	265	88	45
1995	253	87	46
1996	243	102	61
1997	178	70	44
1998	233	97	38
1999	197	74	41
2000	105	45	17
2001	145	64	37
2002	108	38	23
2003	138	47	19

B. Number of radiological incidents reported through the internal LANL RIR system:

Year (CY)	Number of Radiation Incident Reports (RIR)
1993	451
1994	496
1995	549
1996	447
1997	452
1998	530
1999	551
2000	329
2001	423
2002	453
2003	410

5.0 SUMMARY

No significant trends or problems have been noted through CY2003. There was a higher than normal dose from external exposure during the first quarter of CY2003 due work being performed at TA-2, the Omega West site. This was dose that had been anticipated.

Cerro Grande Fire causes data anomalies for CY2000

On May 4, 2000 a controlled burn was initiated on Bandelier National Monument property next to Los Alamos National Laboratory (LANL) property. By May 5th the burn was classified as out of control. By May 7th the fire was close enough to the Los Alamos town site that limited evacuations were called for. Spot fires were also confirmed on LANL property. The Laboratory Director suspended all programmatic work at LANL on May 8th. This was in order to minimize traffic and facilitate the use of public roads for the movement of fire fighting personnel and equipment. LANL was to remain closed until further notice. On May 10th the fire crossed over onto the Los Alamos town site. The towns of Los Alamos and White Rock were evacuated. During the next two weeks LANL was in a shutdown mode and only limited operations were resumed during the week of May 22nd. Although the fire spared the vast majority of LANL buildings and property there was still enough damage to cause a major suspension of operations that continued through all of the remainder of the second quarter of CY2000. Many LANL personnel's homes were destroyed or damaged by the fire.

Due to the fire no TLD badges were issued for the month of June. Personnel were instructed to wear their May TLD badges through June. Limited operations were conducted at LANL from May 5th and during the remainder of the second quarter of CY2000. It can be seen that the external doses for CY2000 are far below normal as well as the values for some of the other performance indicators. Other performance indicators were affected by the fire and subsequent shutdowns.

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- I. Introduction and Purpose** Part of the process of maintaining radiation exposures as low as reasonably achievable (ALARA) includes monitoring ALARA program objectives. The 10CFR835 Implementation Guide stipulates a quarterly and yearly review of the radiological protection program, and it is for assistance in that purpose that this report is generated. In addition, the University of California (UC) contract, under which the UC operates LANL, requires that “Occupational external and tritium radiation exposures are managed to assure that individual doses do not exceed specified limits. An effective ALARA program is in place to manage dose.” This report is a tool used in the tracking and review stages of the performance measures.
- II. Scope** This report includes information from all radiological operations at the Laboratory involving radioactive sources, radioactive materials and machine-generated *ionizing* radiation. This report does not consider nonionizing radiation, environmental radiation, or consumer product radiation. It also does not apply to Laboratory radiological operations at the Nevada Test Site or to other Laboratory radiological operations remote to the Los Alamos area.
- III. Definitions** The following terms have special meaning for this report.
- Facility**—a building, an area within a building, or a group of buildings that constitutes a logical unit for performance goal determination.
- Organization**—the entire Los Alamos National Laboratory or any management subunit (team/section, group, division).
- Performance goal**—a value chosen for a performance indicator (see definition below) to provide a target for improving the radiation protection program. The value, challenging but achievable, is based on historical experience, activities expected to be performed during the goal period, and professional judgment.
- Performance indicator**—a measurable parameter that may be used to suggest the condition of, or trend in, the radiation protection program. Performance indicators are divided into two groups: organizational and facility indicators. *Organizational* indicators are concerned with personnel exposures, while *facility* indicators are concerned with radiological conditions within buildings.
- Radiation worker** - an individual receiving an effective dose equivalent (EDE) of greater than 100 mrem during the calendar year.

IV. Performance Indicators The ALARA performance goals and performance indicators shown below are taken from the *Radiological Performance Goals Program*, Laboratory Standard LS107-05.0, which was developed to address Article 133 – Radiological Performance Reports of the DOE Radiological Control manual (RadCon Manual). Since then LS107-05.0 has been replaced by LIR407-702 ALARA, which only addressed ALARA goals, but not performance reports. Finally, LIR407-702 has been replaced by LIR402-700-01.0, Occupational Radiation Protection Requirements, issued December 22, 2000.

The performance indicators in this report were selected in 1993 when the RadCon Manual was in effect, taken directly from tables of indicators within the Manual. Their use continues to this day for historical consistency. These indicators were selected because they were in keeping with using the fewest number of indicators to provide useful information to management and to trigger improvement. The *10CFR835* Implementation Guide cautions facilities to “select meaningful and measurable performance indicators.”

Organizational ALARA Goals (Exposure Control)

1. effective dose equivalent (whole-body dose)
2. average worker effective dose equivalent (whole body)
3. maximum worker effective dose equivalent
4. maximum neutron dose to a worker
5. maximum extremity dose to a worker

Facility Radiological Performance Indicators

6. number of DOE order 232.1, radiological occurrences
7. number of skin contaminations
8. number of personal clothing contaminations
9. number of nasal contaminations
10. number of airborne monitor alarms (CAM)
11. number of area contaminations

V. Radiological Control Performance Indicators Presentations

EXPOSURE CONTROL

<u>Number</u>	<u>Performance Indicator</u>
1	Effective Dose Equivalent (EDE) - Whole Body
2	Average Worker Non-Zero Dose - Whole Body
3	Maximum Dose to a Worker - Whole Body
4	Maximum Neutron Dose to a Worker
5	Maximum Extremity Dose to a Worker

PI Number 1 Exposure Control - Effective Dose Equivalent

Performance Indicator Definition

The collective effective dose equivalent (whole body) for monitored individuals in each organization. The deep and neutron dose is measured by the primary dosimeter, i.e., thermoluminescent dosimeter (TLD). The tritium whole body dose is assessed through urinalysis and calculation. The collective effective dose equivalent is reported in units of person-rem.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of organizational radiological control programs in maintaining collective site personnel external effective dose equivalents below a pre-selected annual goal and as low as reasonably achievable (ALARA).

Comments

The monthly collective external effective dose equivalent will be plotted in order to discern trends. Totals for previous years will be compared to the current year's cumulative dose to evaluate performance. These values are not static and are subject to change when data is reviewed and updated each March.

Summary

FWO-CGRP is the group with the highest dose through CY2003. The majority of this group's radiation exposure is at TA-2, the Omega West Facility and was recorded during the first quarter of CY2003.

The chart below details the dose history at LANL from 1989. Figure 3 illustrates the monthly breakdown for cumulative external dose since 1994. Figure 4 provides more group details, but includes only the top twenty groups that account for over 80% of the Laboratory's total dose.

<u>Year</u>	<u>Cumulative EDE Dose (person-rem)</u>	<u>TEDE (person-rem)</u>
1989	327	369
1990	229	239
1991	163	255
1992	132	140
1993	142	168
1994	178	183
1995	235	236
1996	189	199
1997	182	200
1998	158	170
1999	129	133
2000	87	212
2001	114	120
2002	160	164
2003	224	224

FIGURE 1
Effective Dose Equivalent – Yearly
(person-rem)

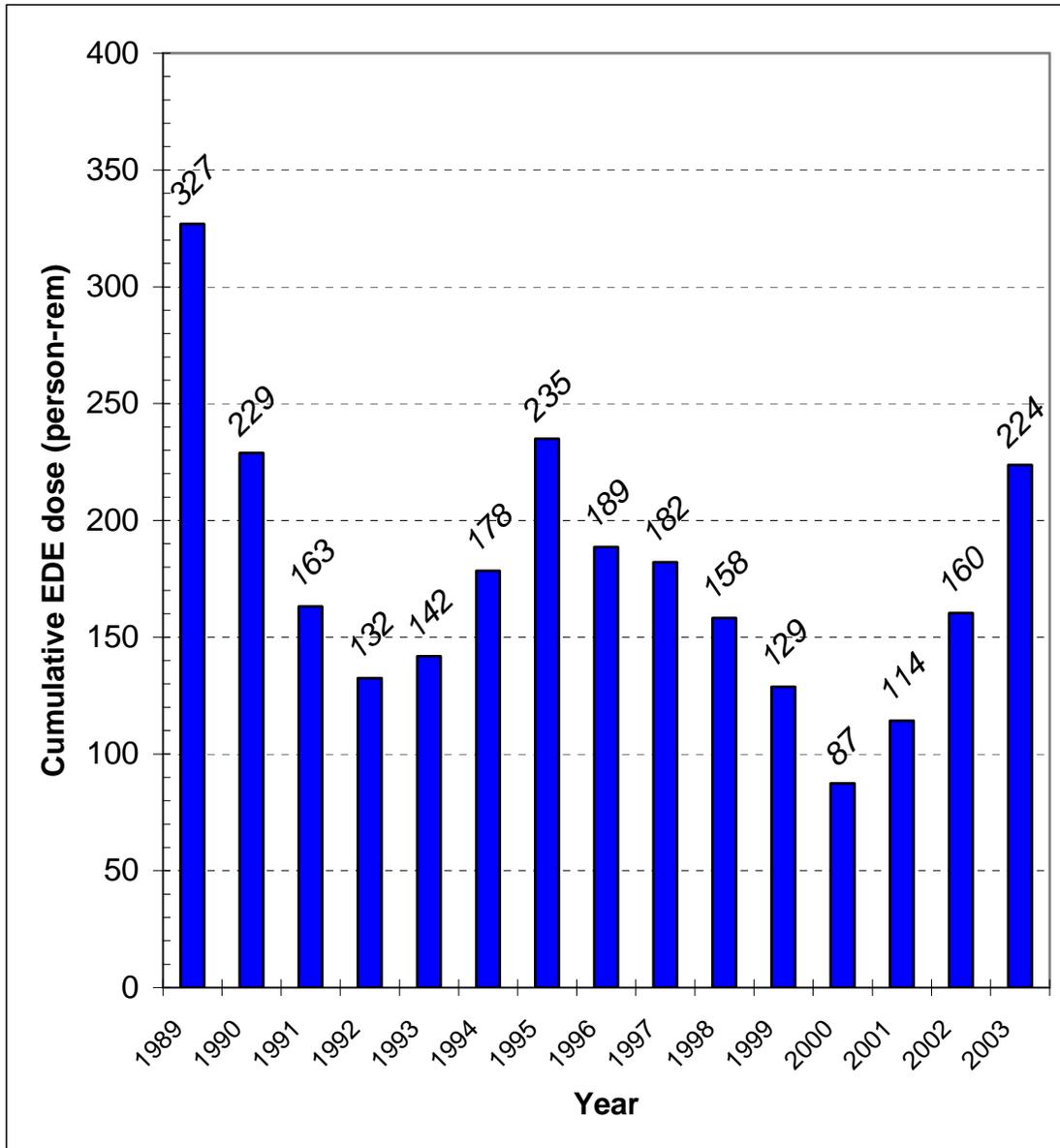


FIGURE 2
Total Effective Dose Equivalent
(person-rem)

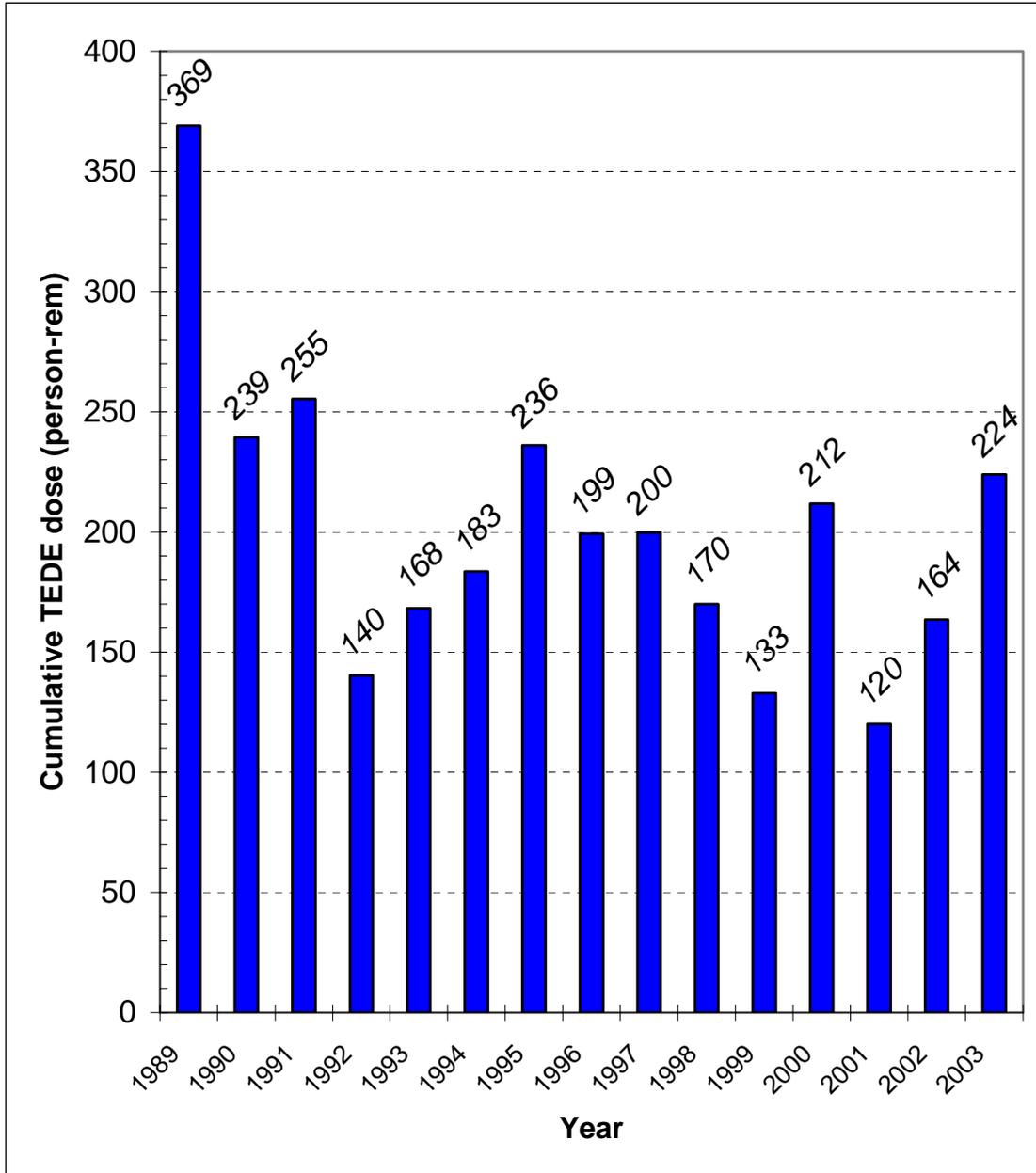


FIGURE 3 Effective Dose Equivalent Cumulative Exposures (person-rem)

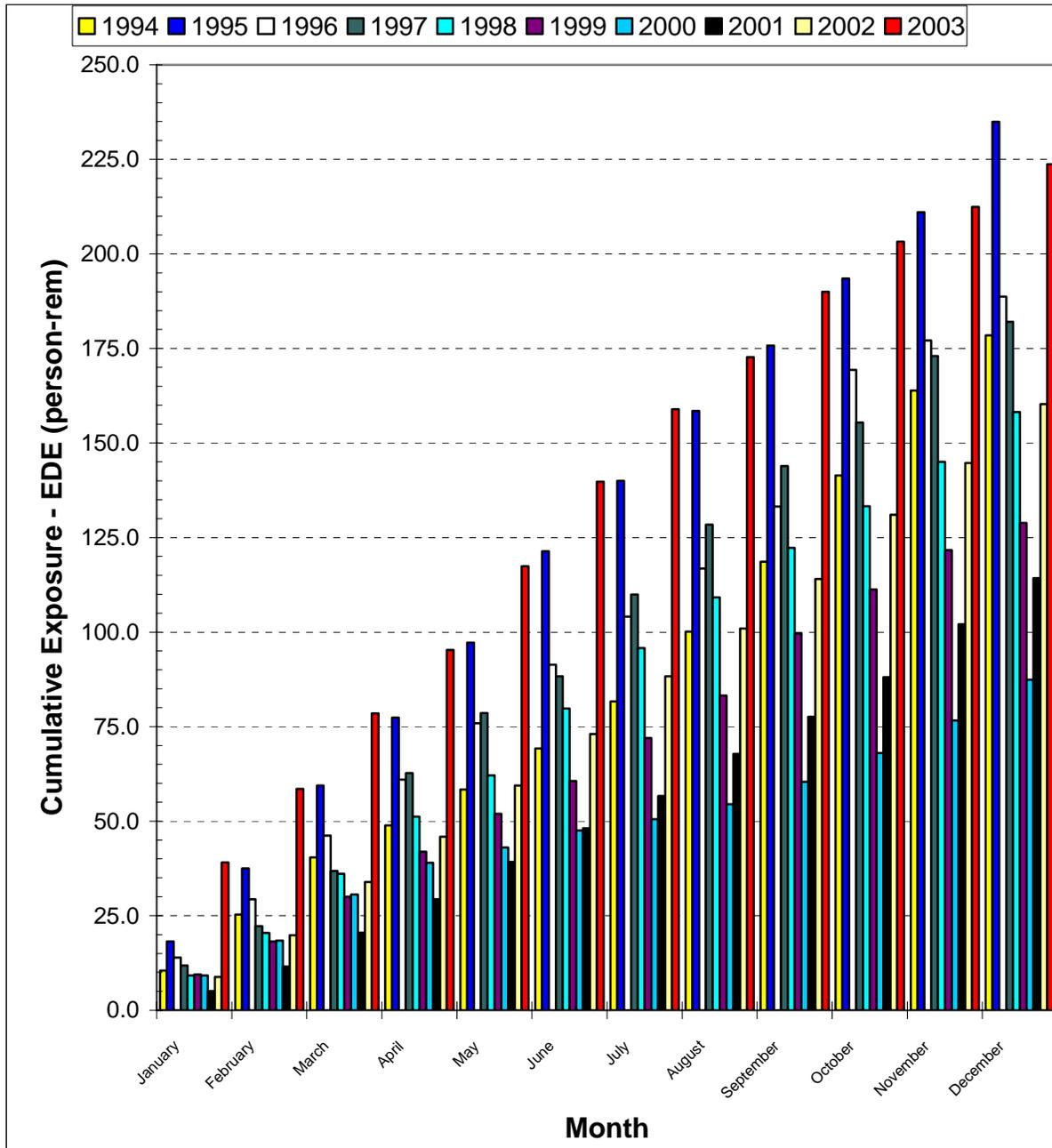
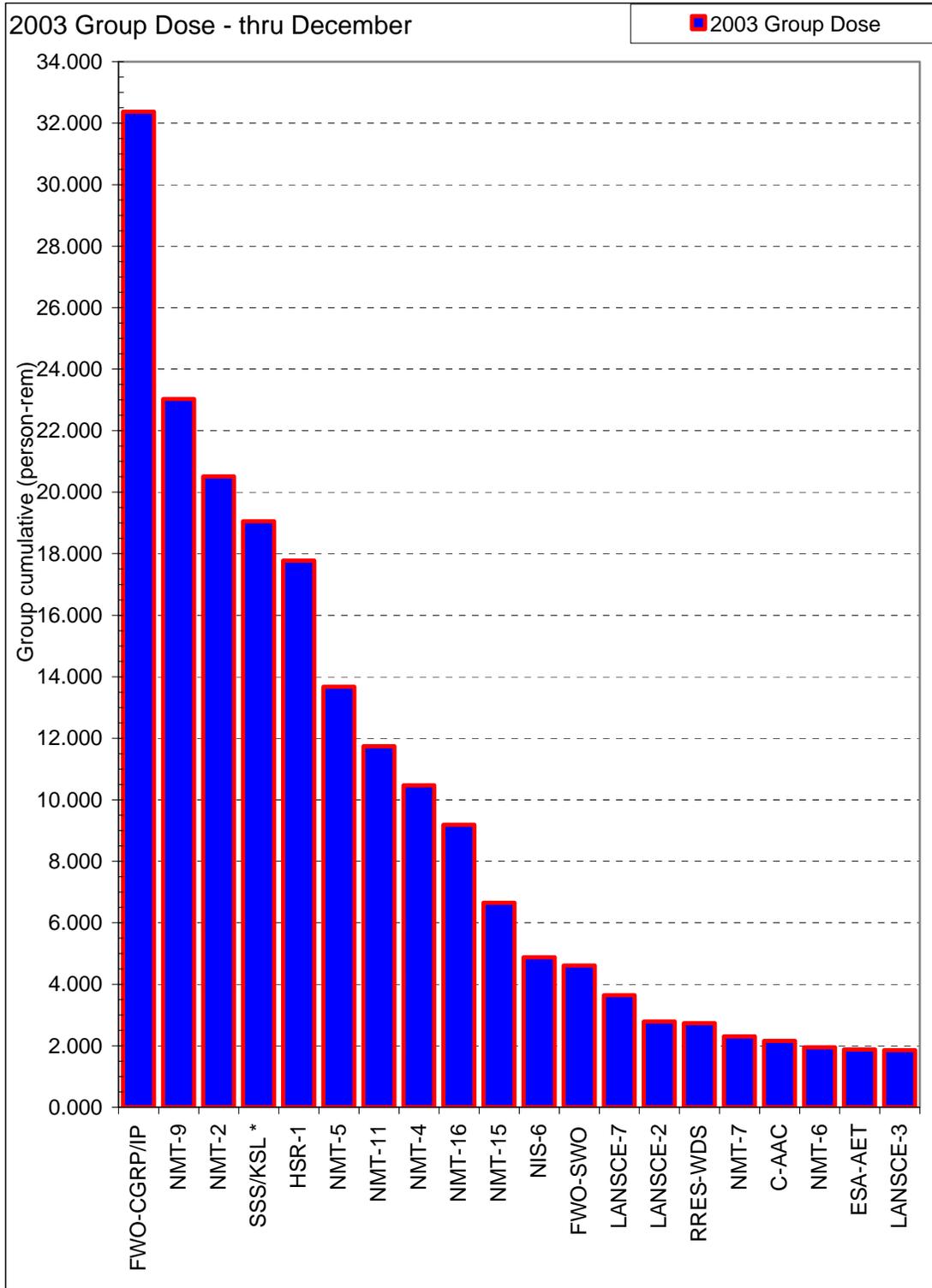


FIGURE 4
Top Twenty Groups (EDE) during CY2003
Los Alamos National Laboratory
(person-rem)



PI Number 2 Exposure Control - Average Worker Non-Zero Dose

Performance Indicator Definition

The average worker non-zero external (deep + neutron) effective dose equivalent (whole body) for each organization. This dose is measured by the primary dosimeter, i.e. thermoluminescent dosimeter (TLD) for deep and neutron. This dose is reported in units of mrem. The average is to be obtained by dividing the total exposure for each evaluation period by the number of individuals at LANL who have non-zero exposures.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of organizational radiological control programs in maintaining average worker external effective dose equivalents below a pre-selected annual goal and as low as reasonably achievable (ALARA).

Comments

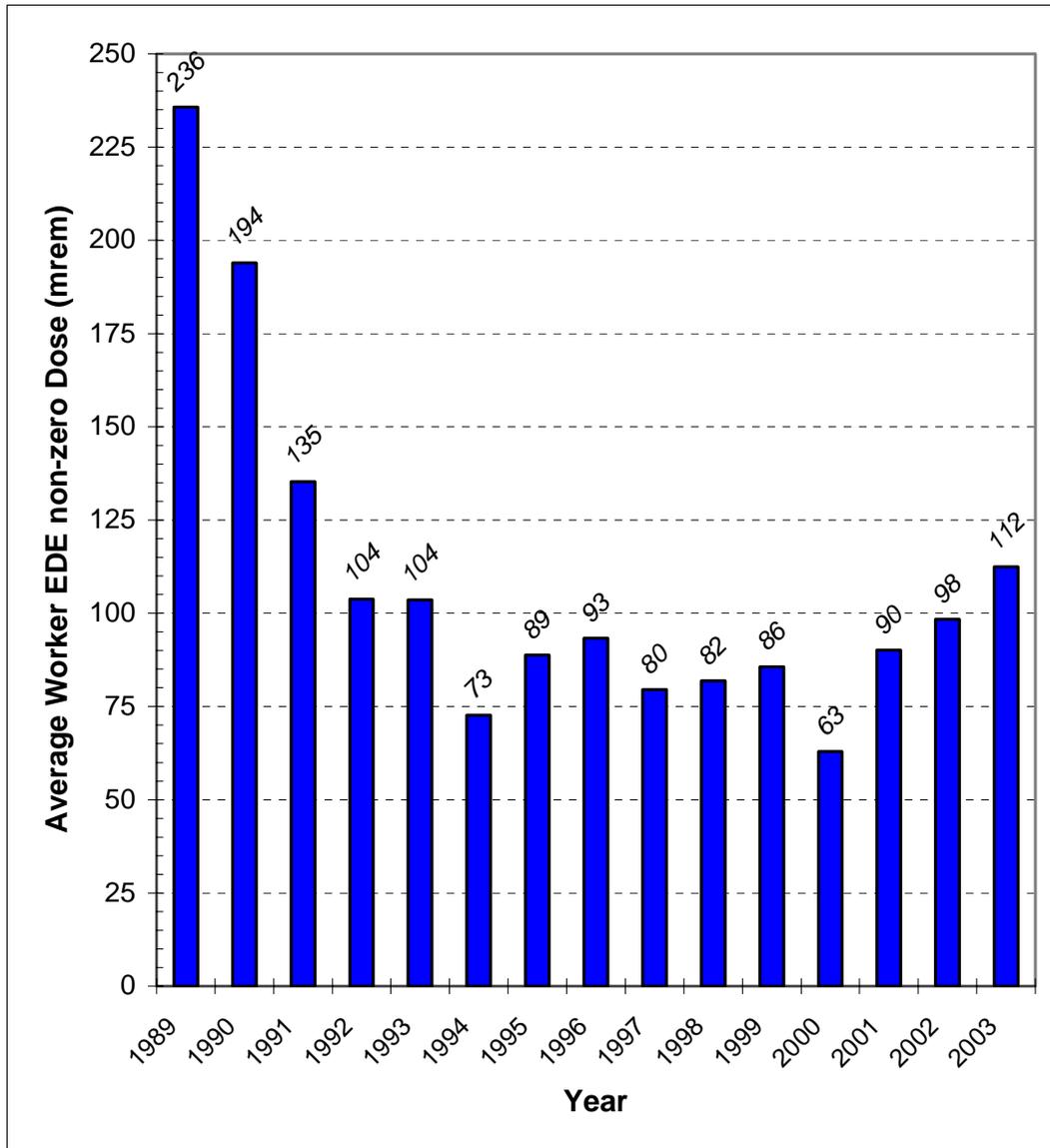
Each year the average worker non-zero dose - whole body will be plotted. The previous year's dose is also shown in an effort to determine trends.

Summary

As can be seen in figure 5, the overall trend since 1994 has been a steady one overall and has seen a dramatic reduction from levels seen prior to 1992. There is indication of a slowly increasing trend since 1997, exclusive of the abnormal results seen in 2000.

<u>Year</u>	<u>Average Worker EDE (mrem)</u>		<u>EDE(mrem)</u>
	<u>Non-zero Dose</u>	<u># Non-Zero</u>	
1989	236	1387	326930
1990	194	1180	228850
1991	135	1207	163253
1992	104	1277	132494
1993	104	1369	141811
1994	73	2454	178441
1995	89	2646	234934
1996	93	2023	188698
1997	80	2289	182020
1998	82	1933	158208
1999	86	1504	128855
2000	63	1389	87418
2001	90	1267	114257
2002	98	1630	160308
2003	112	1989	223726

FIGURE 5
Average Worker non-zero Dose
Effective Dose Equivalent
(mrem)



PI Number 3 Exposure Control - Maximum Effective Dose Equivalent to a Worker

Performance Indicator Definition

The maximum effective dose equivalent (whole body) to a worker in each month. This dose is measured by the primary dosimeter, i.e., thermoluminescent dosimeter (TLD) for deep and neutron. This dose is reported in units of mrem.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of organizational radiological control programs in maintaining the maximum effective dose equivalent (whole body dose) to a worker below a pre-selected annual administrative control level and as low as reasonably achievable (ALARA).

Comments

The maximum whole body dose to a worker (cumulative) will be plotted for the year. Data from previous years will be included for comparison. These values are not static and are subject to change when the data is reviewed and updated each March.

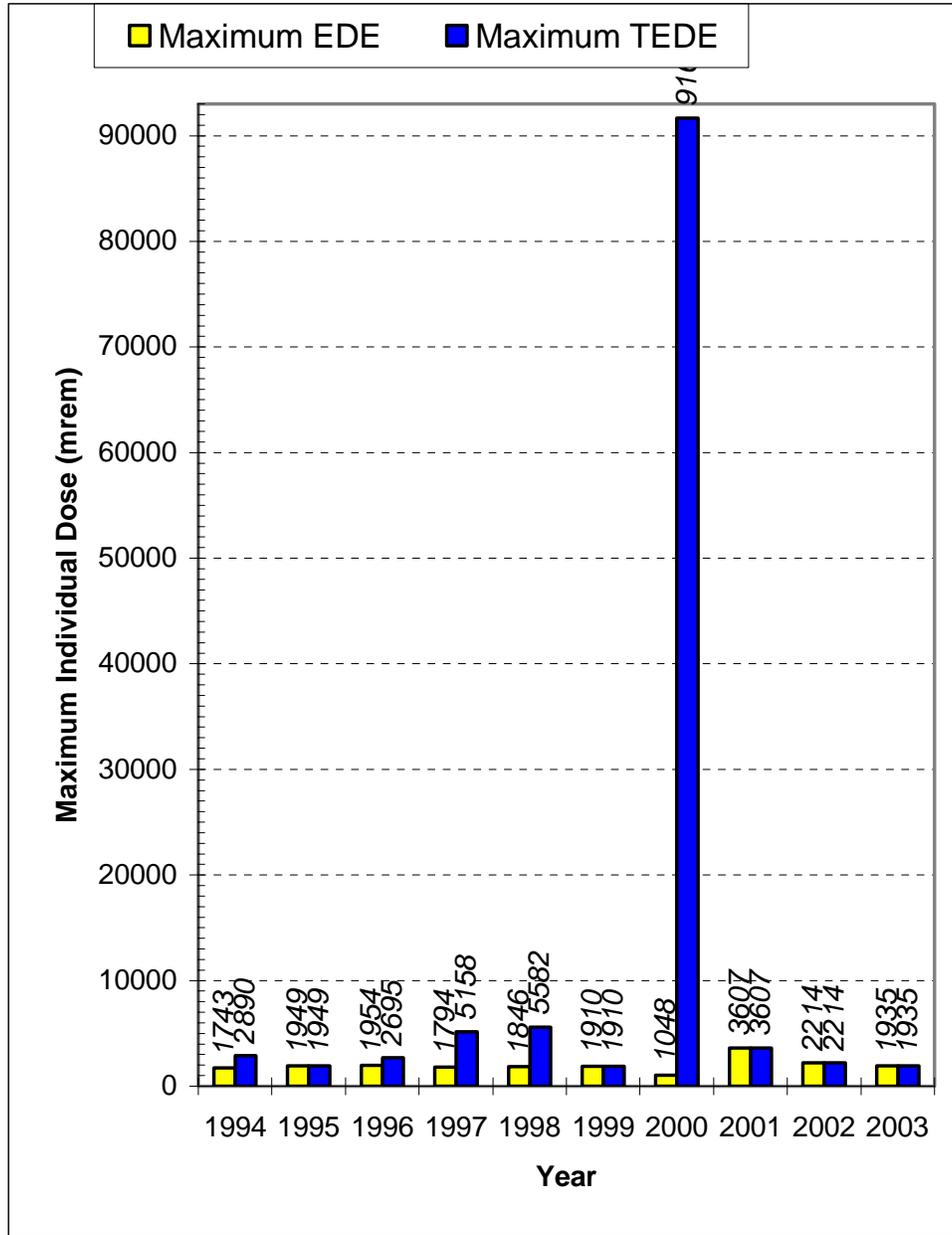
Summary

The maximum confirmed effective dose to a worker through CY2003 was 1935 mrem. This individual works with NMT-9 at TA-55. The value listed for CY2001 is under investigation, and the 2214 mrem in CY2002 was an exposure that had prior approval to exceed 2000 mrem. The majority of external dose exposure in CY2003 was found at TA-2, the Omega West site.

The legal limit (10CFR835) for whole body dose (TEDE) is set at 5000 mrem. The maximum dose received at LANL in the past eight years was 91.6 rem recorded in 2000, and was the result of one unplanned exposure (ALO-LA-LANL-TA55-2000-0009).

<u>Year</u>	<u>EDE Dose(mrem)</u>	<u>TEDE Dose(mrem)</u>
1994	1743	2890
1995	1949	1949
1996	1954	2695
1997	1794	5158
1998	1846	5582
1999	1910	1910
2000	1048	91656
2001	3607	3607
2002	2214	2214
2003	1935	1935

FIGURE 6
Maximum Effective Dose Equivalent to a Worker
(mrem)



PI Number 4 Exposure Control - Maximum Neutron Dose to a Worker

Performance Indicator Definition

The maximum external effective dose equivalent from neutrons to a worker in each organization as measured by the primary dosimeter, i.e., thermoluminescent dosimeter (TLD). This dose equivalent is reported in units of mrem.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of organizational radiological control programs in maintaining the maximum external effective dose equivalent from neutrons to a worker below a pre-selected annual goal and as low as reasonably achievable (ALARA).

Comments

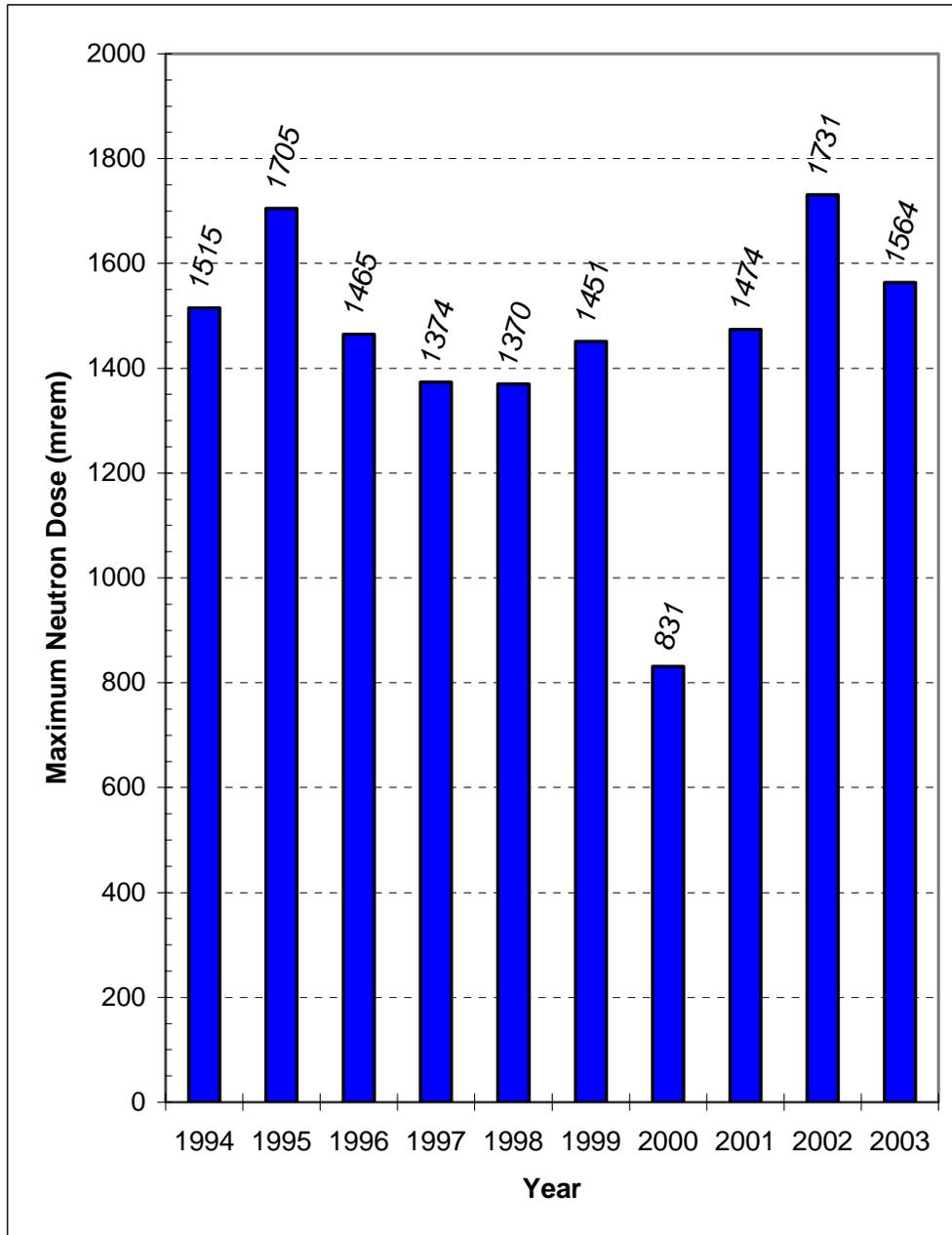
The maximum neutron dose to a worker will be plotted for the current calendar year and compared to previous years.

Summary

The maximum neutron dose to a worker through CY2003 was 1564 mrem and was recorded by an individual assigned to a group located at TA-55.

<u>Year</u>	<u>Dose(mrem)</u>	<u>Location</u>
1994	1515	TA-55
1995	1705	TA-55
1996	1465	TA-55
1997	1374	TA-55
1998	1370	TA-55
1999	1451	TA-55
2000	831	TA-55
2001	1474	TA-55
2002	1731	TA-55
2003	1564	TA-55

FIGURE 7
Maximum Neutron Dose to a Worker
(mrem)



PI Number 5 Exposure Control – Maximum Extremity Dose to a Worker

Performance Indicator Definition

The maximum extremity dose to a worker as measured by secondary dosimetry; finger rings, wrist bands. This dose equivalent is reported in units of mrem.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of organizational radiological control programs in maintaining extremity doses as low as reasonably achievable (ALARA).

Comments

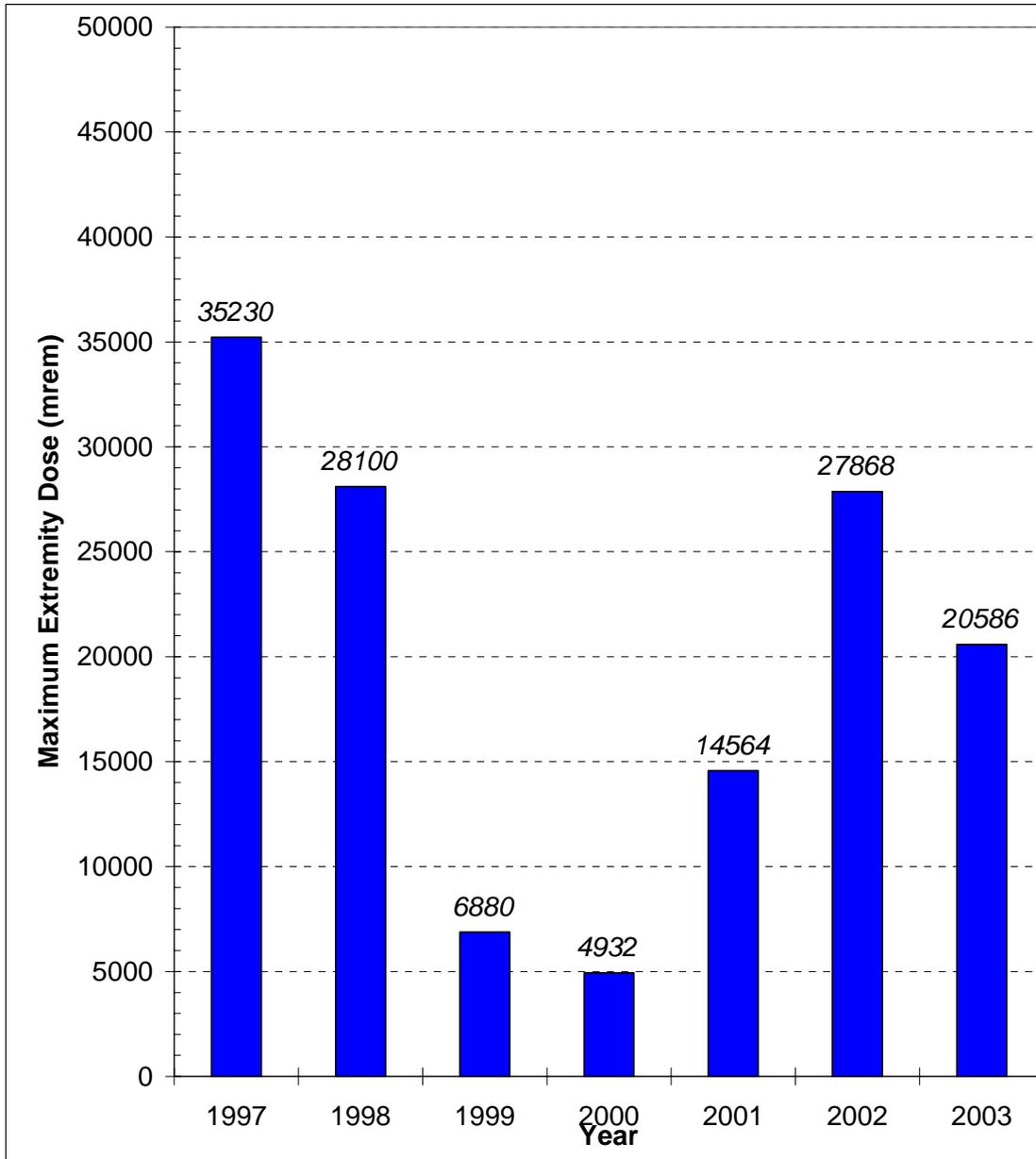
The maximum extremity dose to a worker will be plotted for the current calendar year and compared to previous years. This indicator has only been tracked since CY1997.

Summary

The maximum extremity dose to a worker through CY2003 was 20,586 mrem. The maximum extremity dose during the past five years was 35,230 mrem recorded in 1997.

<u>Year</u>	<u>Dose(mrem)</u>	<u>Location</u>
1997	35230	TA-55
1998	28100	TA-55
1999	6880	TA-55
2000	4932	TA-55
2001	14564	TA-55
2002	27868	TA-55
2003	20586	TA-55

FIGURE 8
Maximum Extremity Dose to a Worker
(mrem)



RADIOLOGICAL PERFORMANCE INDICATORS

<u>Number</u>	<u>Performance Indicator</u>
6	Number of DOE Order 232.1, Radiological Occurrences (personnel)
7	Number of Skin Contaminations
8	Number of Personal Clothing Contaminations
9	Number of Nasal Contaminations
10	Number of Continuous Airborne Monitor Alarms (CAM)
11	Number of Area Contaminations

**PI Number 6 Radiological Performance Indicators -
Number of DOE Order 232.1, Radiological
Occurrences (personnel)**

Performance Indicator Definition

The number of DOE Order 232.1 radiological occurrences of a personal contamination nature. These occurrences are skin contaminations, nasal contaminations and personal clothing contaminations.

Performance Indicator Purpose

The purpose of this indicator is to monitor the performance of the radiological protection program, other than dosimetry. Such as personal protective equipment (PPE), engineered designs, ventilation, etc.

Comments

To display the values for this performance indicator (and all others), they are divided into four categories: the two main radiological facilities {the plutonium processing and handling facility (TA-55) and the chemistry and metallurgy research facility (CMR)}; the remaining occurrences at the other LANL facilities; and the total LANL occurrences. The values reported are the number of occurrence reports, and may not reflect the number of individuals contaminated. Performance Indicators 7, 8 and 9 will reflect numbers of individuals involved in personnel contaminations on the following pages.

Summary

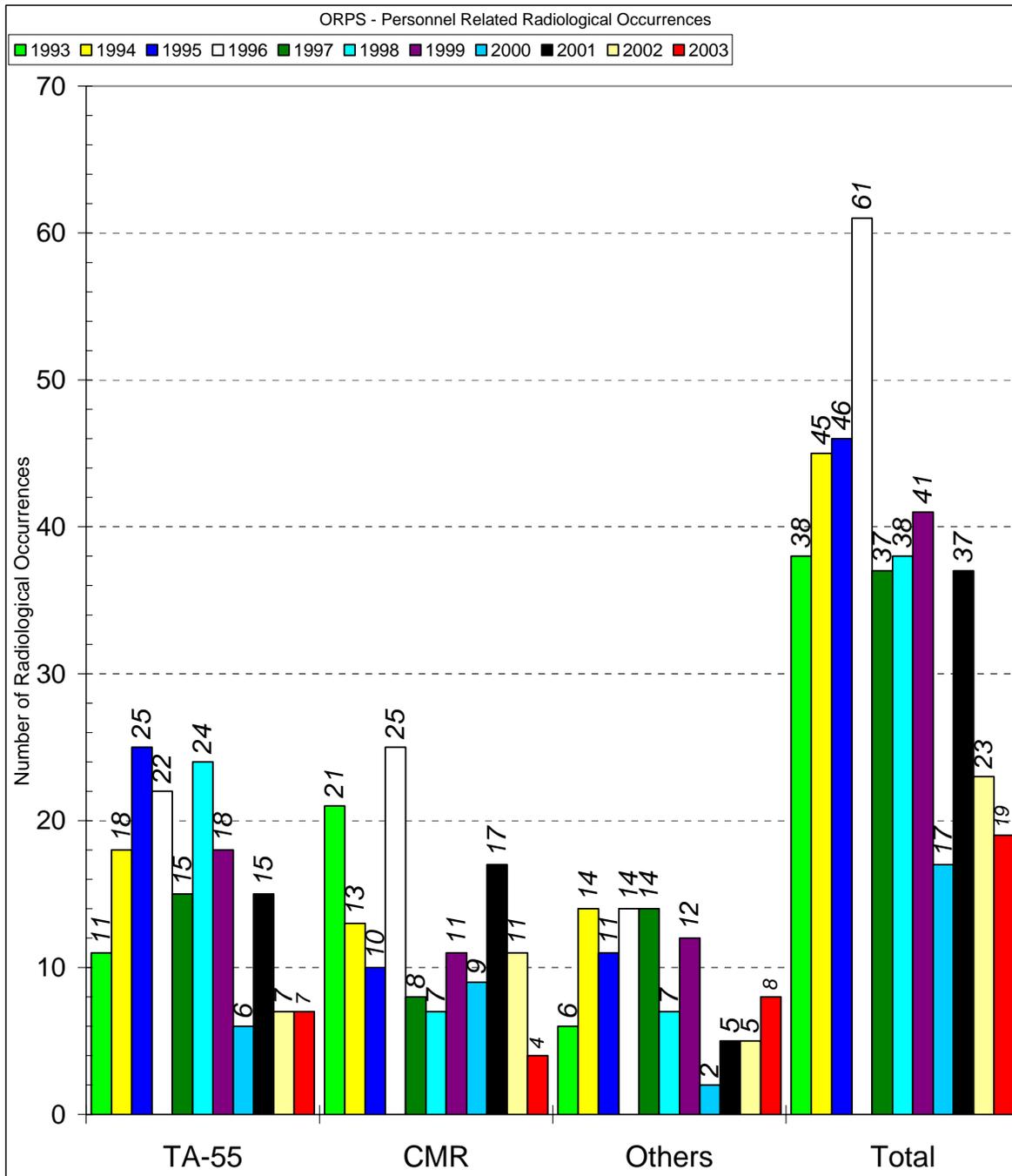
The number of radiological occurrences has remained steady with a peak year in 1996 and a minimal year in 2000 due to the Cerro Grande fire. Through CY2003 the number of occurrences has remained steady.

Year	Number of Occurrences			
	TA-55	CMR	Others	Total
1993	11	21	6	38
1994	18	13	14	45
1995	25	10	11	46
1996	22	25	14	61
1997	15	8	14	37
1998	24	7	7	38
1999	18	11	12	41
2000	6	9	2	17
2001	15	17	5	37
2002	7	11	5	23
2003	7	4	8	19

Normalization

The ratio of radiation workers to occurrences (number of rad workers : number of occurrences) was 8.6 in 1994 (i.e., there was one occurrence for every 8.6 rad workers), 8.9 in 1995, 7.4 in 1996, 10.5 in 1997, 9.6 in 1998, 7.1 in 1999, 13.1 in 2000, 7.7 in 2001, 10.1 in 2002 and 26.9 through CY2003.

FIGURE 9
Number of DOE Order 232.1
Radiological Occurrences (personnel related)



PI Number 7 Radiological Performance Indicators - Number of Skin Contaminations

Performance Indicator Definition

The number of skin contaminations for all personnel (including visitors and contractors) in each organization for which the levels exceeded DOE Order 232.1 reporting levels.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of engineered controls and worker performance to contain contamination at the source.

Comments

The number of skin contaminations will be plotted for the year. The totals for previous years will be displayed for trending and comparison.

Summary

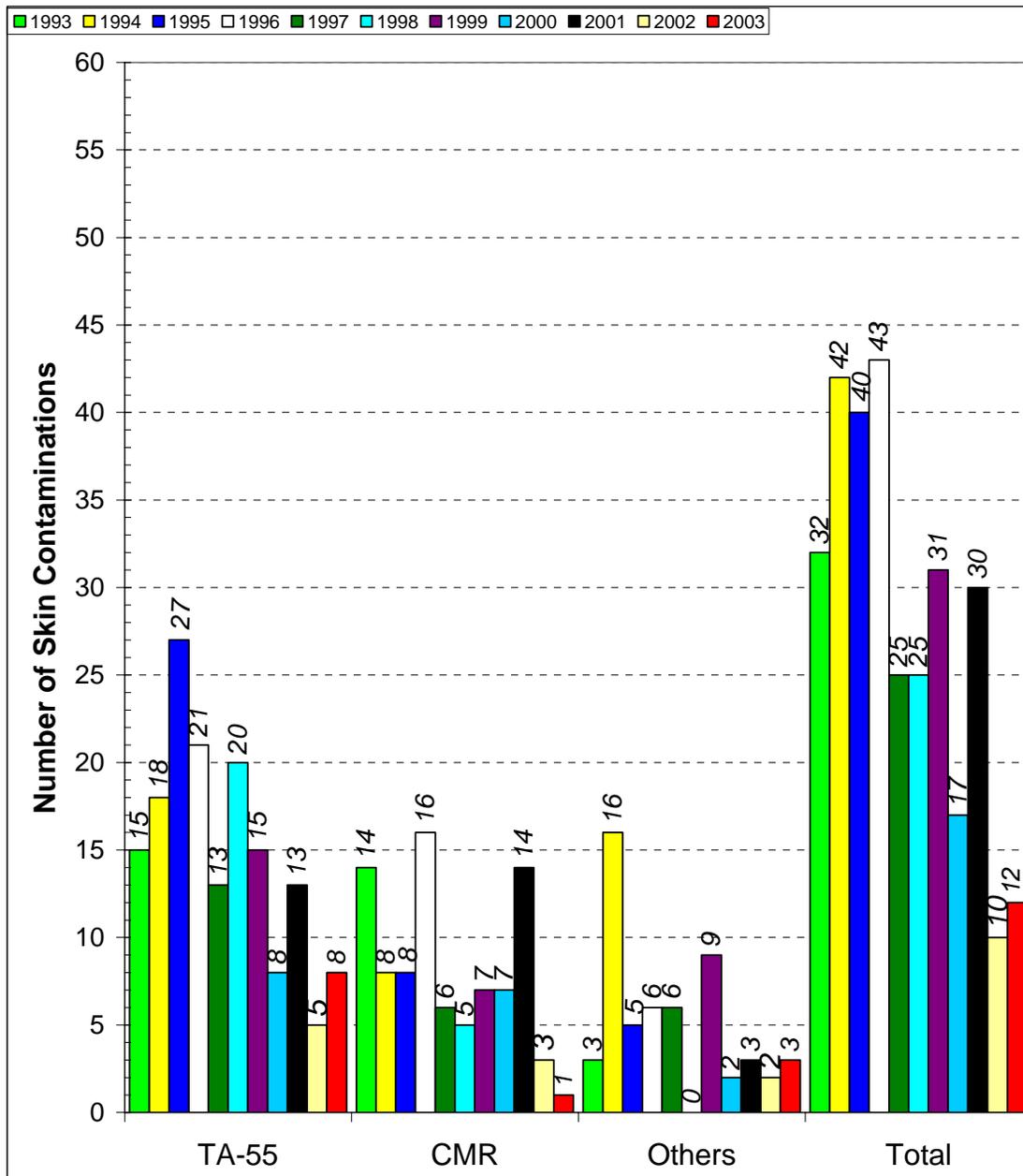
The number of skin contaminations has remained steady in all areas at LANL through CY2003.

<u>Year</u>	<u>Number of Skin Contamination Occurrences</u>			<u>Total</u>
	<u>TA-55</u>	<u>CMR</u>	<u>Others</u>	
1993	15	14	3	32
1994	18	8	16	42
1995	27	8	5	40
1996	21	16	6	43
1997	13	6	6	25
1998	20	5	0	25
1999	15	7	9	31
2000	8	7	2	17
2001	13	14	3	30
2002	5	3	2	10
2003	8	1	3	12

Normalization

The ratio of radiation workers to skin contaminations (number of rad workers : number of skin contaminations) was 9.2 in 1994 (i.e., there was one skin contamination for every 9.2 rad workers), 10.2 in 1995, 10.5 in 1996, 15.6 in 1997, 14.6 in 1998, 9.4 in 1999, 13.1 in 2000, 9.5 in 2001, 38.2 in 2002 and 42.7 through CY2003.

FIGURE 10 Number of Skin Contamination Occurrences



PI Number 8 Radiological Performance Indicators - Number of Personal Clothing Contaminations

Performance Indicator Definition

The number of personal clothing contaminations for all personnel (including visitors and contractors) in each organization for which the levels exceeded DOE Order 232.1 reporting levels.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of engineered controls and worker performance to contain contamination at the source.

Comments

The number of personal clothing contaminations will be plotted for the year. The totals for previous years will be displayed for comparison.

Summary

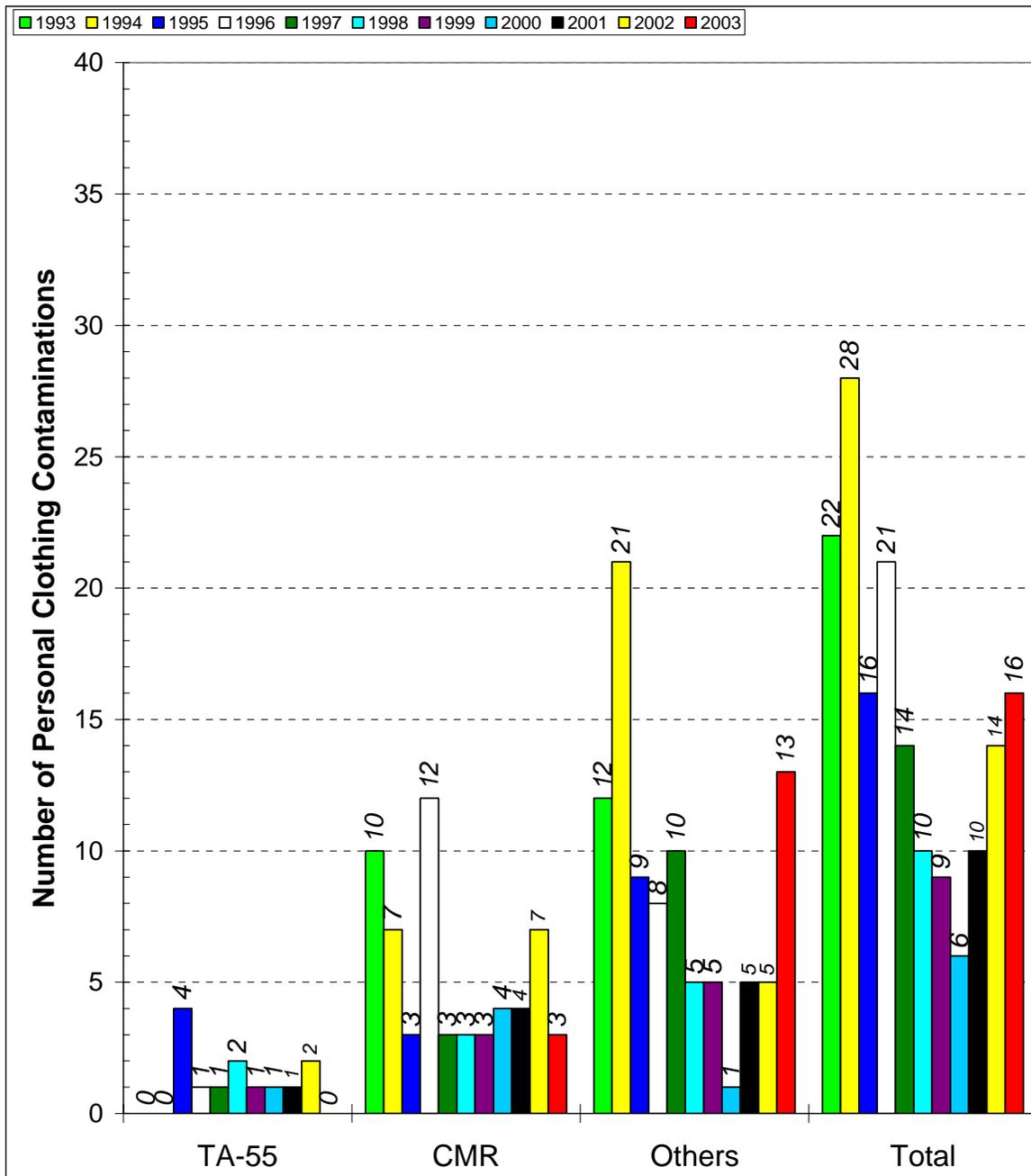
The total number of personal clothing contaminations has remained steady. There had been a declining trend at LANL from 1994 through 2000, but for the past three years the trend is one of increasing contaminations.

Number of Personal Clothing Contamination Occurrences				
<u>Year</u>	<u>TA-55</u>	<u>CMR</u>	<u>Others</u>	<u>Total</u>
1993	0	10	12	22
1994	0	7	21	28
1995	4	3	9	16
1996	1	12	8	21
1997	1	3	10	14
1998	2	3	5	10
1999	1	3	5	9
2000	1	4	1	6
2001	1	4	5	10
2002	2	7	5	14
2003	0	3	13	16

Normalization

The ratio of radiation workers to personal clothing contaminations (number of rad workers : number of contaminations) was 13.8 in 1994 (i.e., there was one personal clothing contamination for every 13.8 rad workers), 25.6 in 1995, 21.4 in 1996, 27.8 in 1997, 36.5 in 1998, 32.4 in 1999, 37.0 in 2000, 28.6 in 2001, 27.4 in 2002 and 32.0 through CY2003. This illustrates a steady "normalized" trend in personal clothing contaminations.

FIGURE 11
Number of Personal Clothing Contaminations



**PI Number 9 Radiological Performance Indicators -
Number of Nasal Contaminations**

Performance Indicator Definition

The number of positive nasal contaminations for all personnel (including visitors and contractors) in each organization for which the contamination exceeded DOE Order 232.1 reporting levels.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of engineered controls and worker performance to contain contamination at the source.

Comments

The number of nasal contaminations for all personnel will be plotted for the current year. Data from previous years (totals) will be included for comparison.

Summary

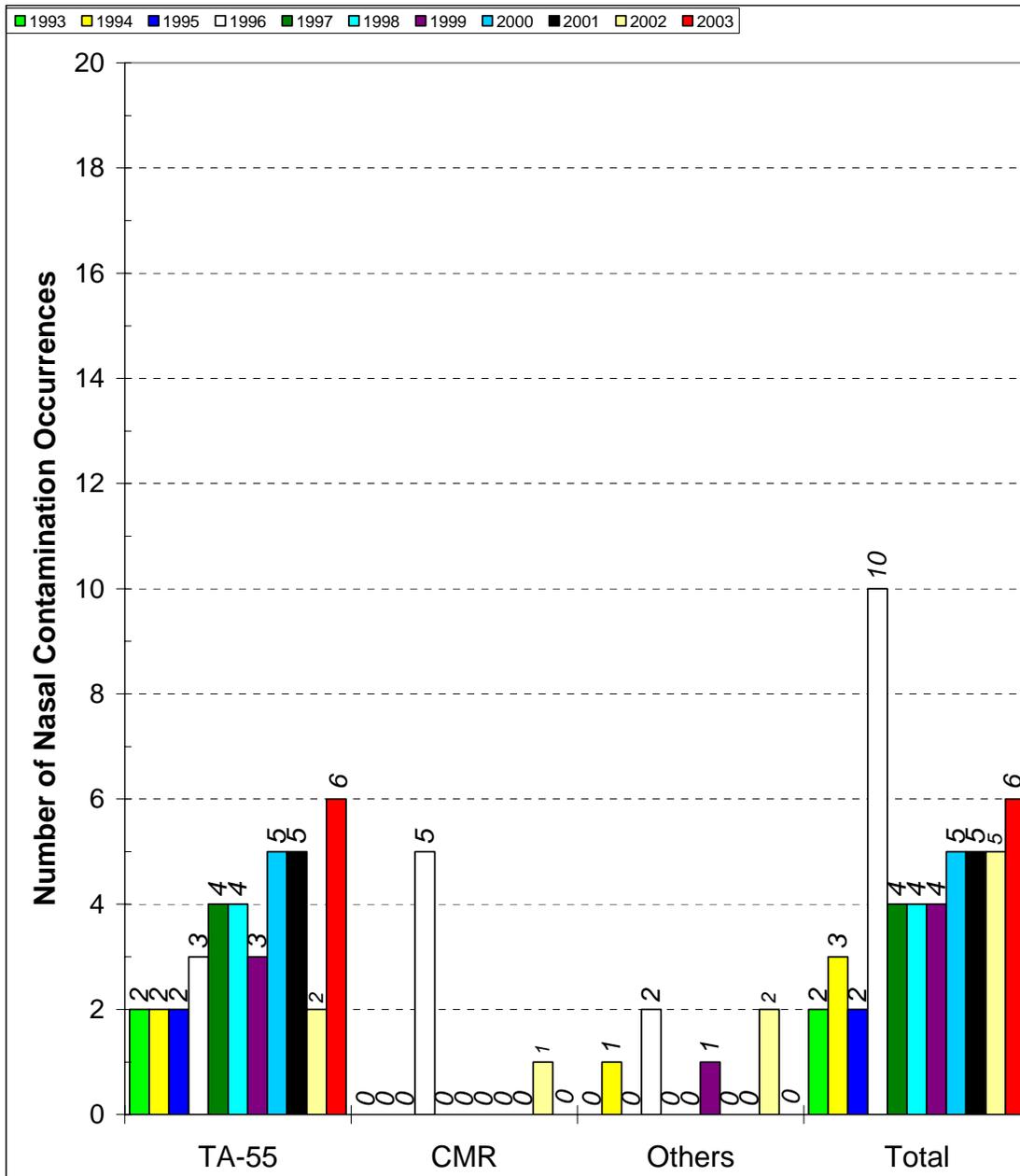
Any statistical evaluation would be extremely suspect due to the limited number of data points and the purely random nature of the data. No significant trends can be determined. The five nasal contaminations recorded for TA-55 in CY2000 were the result of one occurrence (ALO-LA-LANL-TA55-2000-0009).

Number of Nasal Contamination Occurrences				
<u>Year</u>	<u>TA-55</u>	<u>CMR</u>	<u>Others</u>	<u>Total</u>
1993	2	0	0	2
1994	2	0	1	3
1995	2	0	0	2
1996	3	5	2	10
1997	4	0	0	4
1998	4	0	0	4
1999	3	0	1	4
2000	5	0	0	5
2001	5	0	0	5
2002	2	1	2	5
2003	6	0	0	6

Normalization

Due to the statistically small numbers involved with this performance indicator, no normalization has been attempted.

FIGURE 12 Number of Positive Nasal Contaminations



PI Number 10 Radiological Performance Indicators - Number of Continuous Airborne Monitor Alarms

Performance Indicator Definition

The number of true continuous airborne monitor (CAM) alarms for the Laboratory that were reported in accordance with DOE Order 232.1 criteria. True alarms are defined as those alarms that are initiated by the presence of radioactivity on the monitor filter as confirmed by analysis.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of facility airborne radioactivity monitoring programs as well as the effectiveness of facility airborne contamination control programs.

Comments

The cumulative number of CAM alarms will be plotted for the current year. Data from previous years will be included for comparison.

Summary

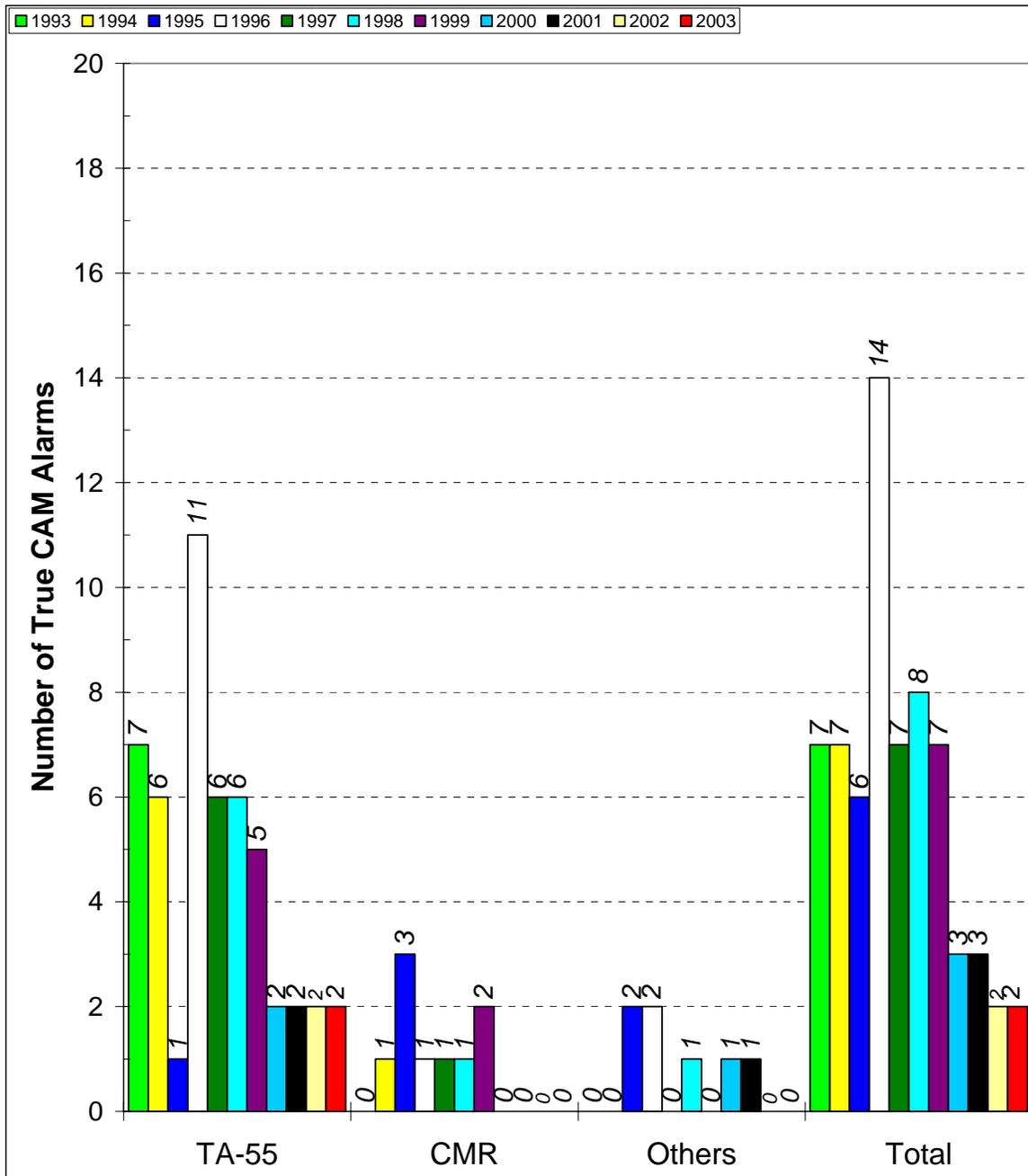
Due to the small numbers involved with this performance indicator no significant trends can be determined.

<u>Year</u>	<u>Number of CAM Alarm Occurrences</u>			<u>Total</u>
	<u>TA-55</u>	<u>CMR</u>	<u>Others</u>	
1993	7	0	0	7
1994	6	1	0	7
1995	1	3	2	6
1996	11	1	2	14
1997	6	1	0	7
1998	6	1	1	8
1999	5	2	0	7
2000	2	0	1	3
2001	2	0	1	3
2002	2	0	0	2
2003	2	0	0	2

Normalization

Any normalization should be viewed with caution due to the insignificant number of occurrences. The ratio of radiation workers to true CAM's (number of rad workers : number of CAM's) was 55.0 in 1994 (i.e., there was one CAM alarm for every 55 rad workers), 68.3 in 1995, 32.1 in 1996, 55.7 in 1997, 45.6 in 1998, 41.7 in 1999, 74.0 in 2000, 95.3 in 2001, 191.5 in 2002 and 256.0 through CY2003.

FIGURE 13
Number of Continuous Airborne Monitor Alarms (CAM)



**PI Number 11 Radiological Performance Indicators -
Number of Area Contaminations**

Performance Indicator Definition

The number of area contaminations within the Laboratory boundaries that were reported in accordance with DOE Order 232.1 criteria.

Performance Indicator Purpose

The purpose of this indicator is to measure the effectiveness of engineered controls and worker performance to contain contamination at the source.

Comments

The number of area contaminations will be plotted in comparison to previous years. The specific locations of these contaminations are listed on the reports. No determination has been made as to whether these occurrences were inside or outside of a radiologically controlled area, only that the contamination qualified for the DOE O232.1 criteria. This normally means contaminations outside a radiologically controlled area or unanticipated contamination within a radiologically controlled area.

Summary

The number of area contaminations has seen a decreasing trend during the past ten years .

Number of Area Contamination Occurrences				
<u>Year</u>	<u>TA-55</u>	<u>CMR</u>	<u>Others</u>	<u>Total</u>
1993	20	23	39	82
1994	10	7	42	59
1995	9	9	30	48
1996	4	13	14	31
1997	4	6	17	27
1998	5	8	16	29
1999	6	4	12	22
2000	1	7	5	13
2001	6	3	11	20
2002	4	2	5	11
2003	4	2	7	13

Normalization

The ratio (number of rad workers : number of area contaminations) was 6.5 in 1994 (i.e., there was one area contamination for every 6.5 rad workers), 8.5 in 1995, 14.5 in 1996, 14.4 in 1997, 12.6 in 1998, 13.3 in 1999, 17.1 in 2000, 14.3 in 2001, 34.8 in 2002 and 39.4 through CY2003.

FIGURE 14
Number of Area Contaminations

